Fluor-S® MAX MultiImager

Hardware Instruction Manual

for Catalog Number
170-7720

BIO-RAD

Manual Part Number 400-0135 rev. A

Welcome

Dear Customer,

On behalf of Bio-Rad Laboratories, we would like to thank you for investing in the Fluor-S® MAX MultiImaging System and we are sure that it will provide you with many years of high quality imaging.

One of the best ways to familiarize yourself with the capabilities of your new Fluor-S MAX system is to read this manual. In it, you will learn how to set up the system and operate all hardware components. It is also recommended that you read the accompanying software manual, to familiarize yourself with general acquisition functions and data analysis. After reading this manual, please keep it close to your system so that it can be conveniently referred to.

Your Fluor-S MAX system is protected by a comprehensive instrument warranty agreement. Please read this manual thoroughly, so that you fully understand the coverage provided and are aware of your rights and responsibilities. One of the responsibilities of system ownership is regular maintenance. Following the maintenance instructions provided with this manual will help to keep your system and peripherals functioning optimally and will protect your investment. Please also keep in mind that Bio-Rad offers a range of comprehensive service agreements that can be tailored to meet your specific needs.

Bio-Rad Laboratories is dedicated to your total satisfaction and would be pleased to answer any questions or concerns that you may have.

How to Contact Bio-Rad Laboratories

In the United States you can reach Bio-Rad Laboratories at the following numbers:

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For information concerning Bio-Rad Laboratories and its products, visit our Worldwide Web site at **http://www.bio-rad.com**

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Section 1
General Information

1.1 About this Manual

This manual provides instructions for installing, operating and maintaining the Fluor-S MAX MultiImager. This manual uses certain conventions to facilitate understanding of the text material and to assist operators in using the Fluor-S MAX system.

Conventions

Left and right sides of the instrument are as viewed from the front (operator's position) unless otherwise stated.

Commands that are typed in from the keyboard are referred to as <xxxx>, and when you are expected to use the mouse pointer to activate a button it will be referred to as CLICK xxxx. When you are expected to click and drag the mouse to a certain item it will be referred to as SELECT xxxx.

Notes, Cautions and Warnings

Notes, cautions and warnings are used to highlight certain operating procedures and recommendations.

A note indicates a special procedure, an exception to normal operation or something else of specific interest to the reader. Notes are preceded by the word "*Note*" in italics.

A caution precedes an operational step that could damage the instrument or destroy data unless the operator takes certain precautions. Cautions are located in the main text, are preceded by a **Caution:** statement and are accompanied by a "Caution Symbol" in the left margin.

A warning precedes an operating procedure that could cause injury to the operator if not followed correctly. Warnings are located in the main text, are preceded by a **Warning:** statement and are accompanied by a "Warning Symbol" in the left margin.

1.2 Safety Information

Your safety and the safety of others are very important to us. To help you make informed decisions about safety, we have provided comprehensive operating procedures and safety information in this manual and on labels affixed to instrumentation. This information will alert you to any potential hazards.

1.2.1 General Cautions

Caution: Always insert the scan arm lock-down screw located in the back panel of the instrument and tighten by clockwise rotation before moving the Flour-S MAX and avoid subjecting the system to vibration. The scanning mechanism must be disengaged from the case by removal of eight screws from the back panel to allow manual movement of the scan arm to the lock-down position. After correctly positioning the scan arm and engaging the locking screw, reinsert the entire scanning mechanism.

Caution: After transport, always release the scan arm lock-down screw before supplying power to the Fluor-S MAX.

Caution: Ensure that all of the systems ventilation openings are free of interference. Excessive heat build up in the instrument may effect performance or cause operational failure.

Caution: With the exception of cleaning or replacing light bulbs, refer all servicing to qualified Bio-Rad personnel or their agents. If you experience technical difficulties with the instrument, contact Bio-Rad to schedule a service appointment. The instrument should not be modified or altered in any way. Alteration of this instrument voids the manufacturer's warranty and may create a potential safety hazard for the user.

Caution: Bio-Rad is not responsible for any injury or damage caused by the use of this instrument for purposes other than for which it is intended or by the modification of this instrument when not performed by qualified Bio-Rad personnel or an authorized agent.

1.2.2 General Warnings

Warning: There are hazardous voltages inside the scanning mechanism. Do not attempt to defeat the access panel safety interlock or remove service access panels when the instrument is connected to AC power.

Warning: Do not defeat any instrument interlocks; they are designed to prevent user injury.

Warning: The Fluor-S MAX weighs 69.5 kg. Exercise caution when lifting the instrument. It is recommended that at least two persons be used to lift the instrument. Lift the instrument by the two rear hand-holds and grip the metal side covers. Never lift the instrument by the plastic threshold or door.

1.2.3 Power Safety Information

The Fluor-S MAX contains high voltage circuits. The user must disconnect the power cord prior to opening the rear access panel to clean or replace bulbs. A safety interlock latch has been integrated into the system to avoid electrical hazard by preventing users from accidentally opening the system whilst power is still supplied. Please do not attempt to defeat this interlock.

The Fluor-S MAX system is designed and certified to meet EN55011, EN50082-1 and International Electromagnetic Compliance (IEC-1010-1/EN61010 requirements, which are internationally accepted safety standards. Certified products are safe to use when operated in accordance with the instruction manual. This safety certification does not extend to uncertified equipment or accessories, even when connected to the Fluor-S MAX system.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at their own expense.

Figure 1.1 shows the serial number certification label, which is found on the rear panel of the Fluor-S MAX system. This label provides manufacturing data and safety compliance information about the instrument.

For easy customer access, serial number information is also located on the rear face of the optics module door.

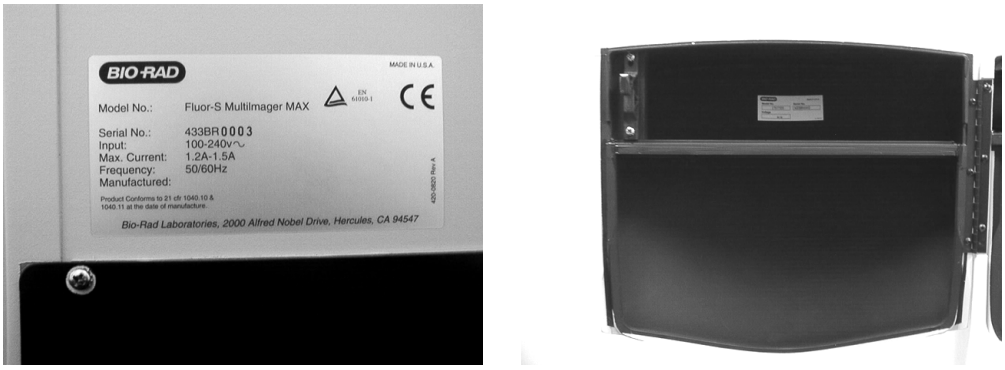


Fig. 1.1. Instrument serial number information located on the rear of the instrument and inside the optics module door.

1.2.4 UV Safety Information

This instrument uses a powerful source of UV radiation and may cause damage to unprotected eyes and skin. The Fluor-S MAX provides safety interlocks on both the door to the sample chamber and optical module to protect the user from accidental UV exposure.

Warning: Do not remove the rear access panel when power is supplied to the instrument or defeat the UV safety interlock. Attempting to operate the unit with the cover removed may damage the instrument and expose the operator to UV radiation.

Warning: Use of controls or adjustments or performance of procedures other than those specified herein may result in exposure to hazardous UV radiation.

A UV radiation symbol (Figure 1.2) is located externally on the rear panel of the instrument.

Fig. 1.2. UV radiation warning symbol.

Section 2
Introduction

2.1 Fluor-S MAX System Capabilities

The Fluor-S MAX MultiImager is a quantitative imaging system for capturing digital images from single and multi-color fluorescence, chemiluminescence, chemifluorescence and colorimetric samples. Using super-cooled CCD technology in combination with a unique ultraviolet illumination mechanism and high efficiency optical design, the Fluor-S MAX offers researchers exceptional sensitivity, uniformity, flexibility and dynamic range for the analysis of electrophoretic samples. With direct imaging and automated acquisition, this system can increase laboratory throughput and eliminate the need for detection methods using x-ray film.

2.2 System Description

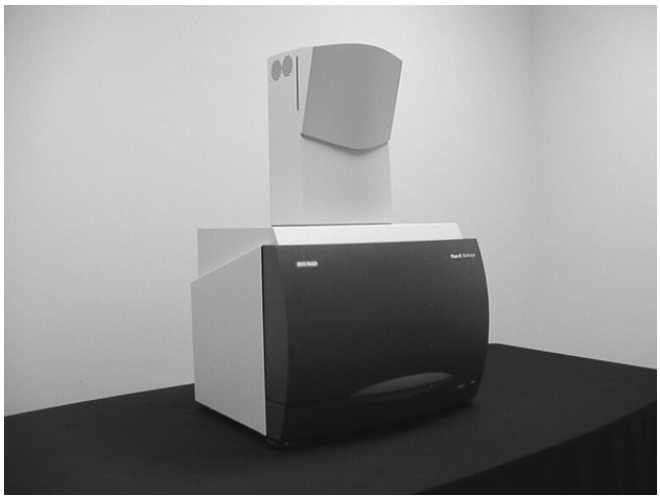


Fig. 2.1. The Fluor-S MAX MultiImager.

The Fluor-S MAX combines several key components into a unique, powerful and fully integrated imaging analysis system:

(1) Super-Cooled CCD Technology

The Fluor-S MAX system uses advanced super-cooled CCD technology for image capture. Low temperature cooling of the large, back-thinned CCD improves image quality by reducing background noise and enhancing the signal to noise ratio. This is particularly important for low light chemiluminescence and fluorescence applications. The 16-bit data collection capability of the Fluor-S MAX dramatically improves the linear dynamic range of the system over that of traditional CCD-based systems.

(2) Unique Scanning and Epi-illumination Source

The Fluor-S MAX system incorporates a unique scanning and epi-illumination system for both UV and white light excitation. This provides high-sensitivity imaging of a

variety of fluorescent, chemiluminescent and colorimetric samples. The broad bandwidth UV excitation (290-365 nm) supports the detection of a broad range of fluorescent dyes in contrast to the limited number of dyes which may be excited using a single wavelength visible laser. The scanning design also provides more uniform illumination than fixed transilluminator bulbs whilst still permitting fast image acquisition. The epi-illumination source provides overhead illumination of opaque samples and materials such as blots and TLC plates.

(3) Interchangeable Lens

The Fluor-S MAX is supplied with two standard lenses. The 28-80 mm, f/3.5-5.6 zoom lens is ideal for most fluorescence and colorimetric applications and allows users image samples from 30 x 25 cm down to 16 x 16 cm. The 50 mm, f1.4 fixed lens has a high light collection efficiency and is the lens recommended for all chemiluminescence applications. An optional 105 mm lens is also available and can be connected to support imaging of small samples at high magnification. The Fluor-S MAX will accommodate most Nikon f-mount lens with a minimum focal distance of 0.65 m.

It is highly recommended that lenses be purchased through Bio-Rad as some Nikon lenses require modification before they can be inserted into the filter wheel housing. Use of an unmodified lens may result in damage to either the instrument or lens mount.

(4) Emission Filters

An eight-position emission filter wheel has been included into the optical design to permit multi-color image discrimination and the detection of many different fluorescent dyes. The Fluor-S MAX is supplied with four standard filters. Filter #1 is optimized for single color detection of ethidium bromide, DNAStar, SYBR® Green, SYBR® Gold, Radiant® Red, SYPRO® Orange, SYPRO® Red, Texas Red®, Cy2, Cy3 and most fluorescein and rhodamine derivatives. Filters #2 and #3 are for the independent detection of green (fluorescein) and red (Texas Red) fluorescence in multiple colored samples. These filters effectively support multiplexing analysis for increased sample throughput and more accurate molecular weight determination. Filter #4 is a clear filter that can be used for white light applications.

Filter position #5 should be left vacant for the optimized collection of chemiluminescent samples. For open filter positions (#6 - #8) are available to users for installation of application specific custom filters.

(5) Quantity One® Control and Analysis Software

The Quantity One software permits user-friendly control of the Fluor-S MAX scanning system and accurate analysis of the captured image or data.

Quantity One is designed for operation in a Windows 95, NT or Macintosh environment and supports fully automated application-based image acquisition. The Quantity One package allows substantial flexibility in the presentation of captured images and provides many tools for data analysis. These include: molecular weight determination, automated lane and band finding, accurate concentration analysis, VNTR and differential display studies and colony counting. Please refer to the Quantity One instruction manual for a full description of this software package.

2.3 Mechanical Description

The Fluor-S MAX MultiImager consists of three main components (Figure 2.2):

1. The scanning module, which integrates the sample scanning chamber, chemiluminescence tray, scanning trans-illumination mechanism and two epi-illumination assemblies.
2. The optics module, which integrates the super-cooled CCD camera, emission filters and filter-wheel and lens.
3. The camera control module.

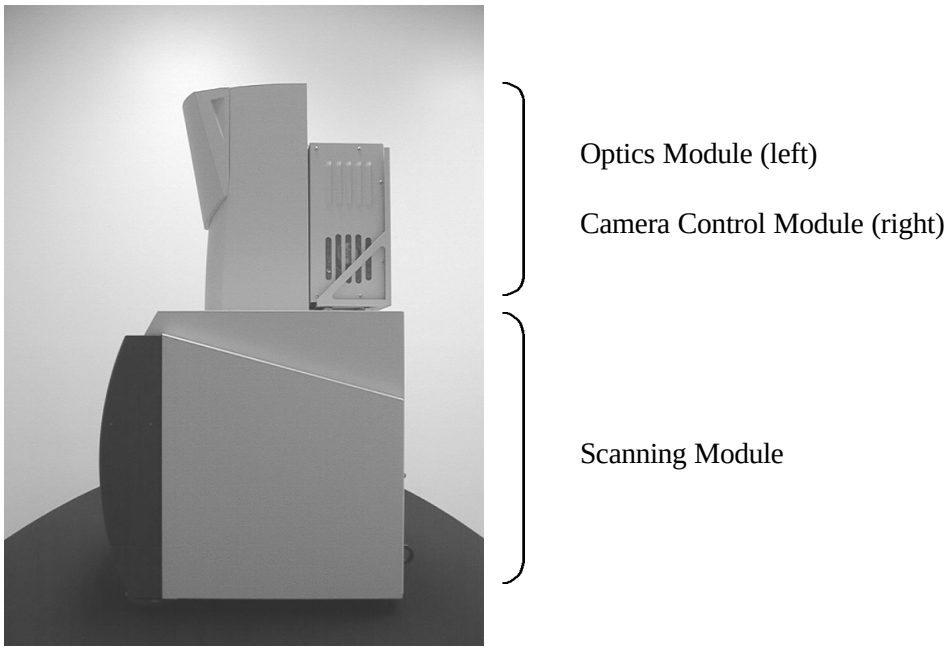


Fig. 2.2. Components of the Fluor-S MAX system.

2.4 Overview of the Imaging Process

The acquisition and analysis of image data using Fluor-S MAX technology is a simple five-part process.

Step 1: Samples to be imaged are placed within the scanning module.

Step 2: The appropriate imaging method is selected in the Fluor-S MAX acquisition window of Quantity One.

Step 3: The sample is aligned using the positioning template in the Quantity One acquisition window.

Step 4: If required the imaging lens is focused onto the sample to obtain the highest quality image.

Step 5: The desired collection time is selected and the image is captured. Once the sample image is collected, it can then be reviewed and analyzed using an appropriate software package.

Section 3
System Installation

3.1 Operating Requirements

3.1.1 System Location

The Fluor-S MAX system should be located in an area that is free of excessive dust or moisture, strong magnetic fields or ionizing radiation. It is also highly recommended that the ambient temperature be stable and within the range of 10°C to 32°C (21°C is optimal) and that the relative humidity not exceed 80%, non-condensing.

Warning: Care should be taken when lifting and moving the Fluor-S MAX system to avoid personal injury. It is recommended that two people, one on each side of the instrument lift the scanning module from the bottom. Do not lift the unit from either the plastic threshold or the main door.

The Fluor-S MAX should be placed on a level bench top with a minimum depth of 70 cm and a height clearance of 180 cm and where there is adequate ventilation for the system's cooling fans to operate. The system's legs allow enough clearance for easy removal of your hands from underneath the instrument, once the system has been placed on the bench.

In placing the Fluor-S MAX, users should also allow for easy access to the scanner power switch, which is located on the lower left hand side of the system's rear panel. The instrument should be placed where there is adequate room to insert the samples into the front of the scanner and where it can be easily connected to the host computer. The maximum distance between the host computer and scanner should be two meters and the instrument is supplied with a SCSI cable of this length.

Note: The host computer should be located at a workstation that minimizes operator fatigue.

3.1.2 AC Power Requirements

The Fluor-S MAX system and its host computer should be connected to a stable grounded power outlet on a circuit free of electrical noise. In addition, a high quality electrical surge suppressor/line filter with a 10 Amp or higher rating should be used to avoid damage from AC fluctuations. Only a grounded 3-pin power cord should be used to connect power.

Caution: The Fluor-S MAX scanner is preconfigured for operation at an input voltage of 110 VAC, at 50-60 Hz. For operation at other voltages the system's power input setting and fuses must be changed by a qualified Bio-Rad service engineer. If your local voltage is anything other than 100-110 VAC please ensure that this change is made before supplying power to the instrument. Failure to do this may permanently damage the Fluor-S MAX system.

3.1.3 Host Computer Recommendations

The Fluor-S MAX system is capable of producing large image files of high resolution. To easily manipulate such large files a powerful computer is required. The host computer MUST meet the specifications as detailed below.

Table 3.1 Host computer specifications

	Recommended PC	Recommended Mac
Processor	Pentium 166 or better	Power Mac 9500 or better
RAM	64 MB or better	64 MB or better
V-RAM	4 MB or better	4 MB or better
Hard Drive	3 GB or better	3 GB or better
Optional Storage	Iomega Jaz	Iomega Jaz
Monitor	17" (21" preferred)	17" (21" preferred)
Communications	Adaptec SCSI-2	Supplied with computer
Operating System	Windows 95 or NT 4.0	OS 7.5 or better

Please refer to your software manual for detailed host computer system and software requirements. If the computer is not purchased from Bio-Rad, systems compatibility is the responsibility of the user. Please check with your local Bio-Rad office regarding compatibility for your specific brand of computer.

3.2 Setting Up the Fluor-S MAX System

There are 3 main phases in the installation of the Fluor-S MAX system:

1. The components are delivered to your laboratory.
2. With the user's assistance, a Bio-Rad installation representative unpacks, sets up and verifies operation of the Fluor-S MAX MultiImager.
3. A Bio-Rad representative trains laboratory personnel on the operation of the Fluor-S MAX, accompanying peripherals and software.

Upon receipt of the Fluor-S MAX, contact your local Bio-Rad representative to arrange system installation and training, if this has not already been coordinated.

Physical setup of the Fluor-S MAX requires the following steps to be completed and takes approximately two hours.

1. Unpack components
2. Perform shipping check
3. Couple the optics module to the scanning module
4. Release the scanning lock-down screw
5. Connect system cables
6. Install emission filters
7. Install lens
8. Connect electrical and host computer communication cables
9. Install software

Each of these steps is detailed in the following sections.

3.2.1 Unpacking the Fluor-S MAX System Components

All Fluor-S MAX components are shipped in a single pallet-supported box. With the assistance of your Bio-Rad installation representative unpack the components by following the steps listed below:

1. Cut the two nylon straps supporting the main instrument package.
2. Slide the cardboard lid off the box vertically. Inside you should see a strapped down scanning module and two large boxes.
3. Remove the two internal boxes and place them in a convenient location. These will be opened later.
4. Cut the two plastic straps holding the scanning module in place and remove the wooden holding frame.
5. With the assistance of a helper, remove the scanning module from the box. Grip the bottom of the scanner on both sides (do not lift the instrument by the front panels) and place it on the bench. When placing the scanner allow clear access to the rear panel for connection of the appropriate cables and removal of the scanning lock-down screw.

Warning: Get a helper; a single person should not attempt to lift the scanner.

Warning: To avoid back injury, always bend your knees and keep a straight back when lifting heavy objects.

Caution: Do not supply power to the scanner until the Fluor-S MAX system has been set up following the installation procedures, the voltage has been correctly configured and the scanning lock-down screw has been removed. Failure to adjust the voltage or remove the lock-down screw before starting the scanner may damage the instrument.

6. Open the two internal boxes and carefully remove all the items.
7. Perform shipping check to confirm that the system has been supplied complete.

3.2.2 Shipping Check

During the unpacking process and in the presence of your Bio-Rad installation representative, inspect all shipping containers to ensure that you have received all ordered items and that no boxes are damaged. If items are either missing or damaged, this should be noted at the time of installation so that it can be immediately reported to both the shipping company and Bio-Rad manufacturing.

The Fluor-S MAX system should arrive complete with the following items:

Quantity	Item
1	Fluor-S MAX Scanning Module
1	Fluor-S MAX Optical Module
1	Camera Control Module & Support Frame
5	Filters (530DF60, 520LP, 610LP, Clear, Cutoff)
2	Lenses (28-80mm Zoom, 50mm Fixed)
1	Adapter Ring for Cutoff Filter on Zoom Lens
1	White Light Diffusion Plate
1	Chemiluminescence Tray
4	System Cables (AIA, camera power, filters, epi)
2	SCSI Interface Cables (Mac and PC)
1	Quantity One Software CD
1	Lens and Filter Cleaning Kit
1	Focusing Target
1	Leveling Bubble
2	Power Cords
2	Instruction Manuals (Hardware and Software)
2	Warranty Cards (Hardware and Software)

Note: Please retain all packaging materials for future transport of the Fluor-S MAX system. Additional charges will be assessed if packaging is not available for instrument warranty shipping.
Note: Please retain the white protective cover that is positioned over the scanning platen. This cover should be used when new users are installing or removing the lens, to prevent component damage from the lens being accidentally dropped.

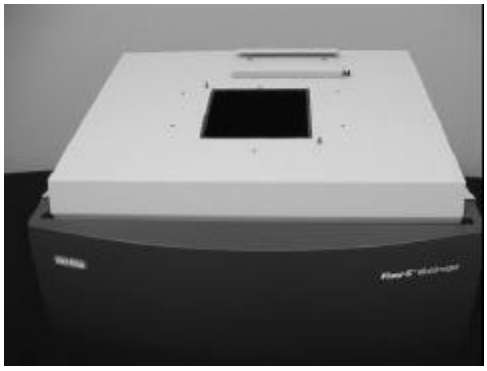
3.2.3 Coupling the Optics Module to the Scanning Module

Follow the procedure outlined below to connect the main hardware components (Figure 3.1):

1. Correctly position the optics module on the top surface of the scanner by matching the two guide holes in the base of the optics module with the locating pins on the top of the scanning module. The optics module should sit completely flat and square on the surface of the scanner to avoid light leaks.
2. Open the door to the scanning module, reach inside to the top panel of the sample chamber and tighten the six captive thumbscrews. First hand-tighten and then follow up with a flat head screwdriver to ensure that a light-tight seal is formed.

Warning: The epi-illumination sources in the sample chamber may have sharp edges. Be careful when reaching into the sample chamber to keep your arm in the center of the unit and avoid contact with the epi-assemblies.

3. Install the camera control unit onto the scanning module by carefully sliding the support frame into the guide tracks. The frame holding the control unit should be inserted with the flat, labeled panel facing away from the scanner.
4. Lock the camera controller into position by tightening the captive thumb-screw on the lower right hand side of the frame.



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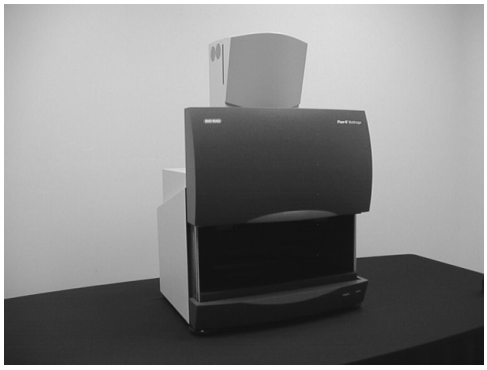

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Fig. 3.1. Steps on connecting main Fluor-S MAX components.

3.2.4 Releasing the Scan Lock-Down Screw

To protect the scanning mechanism during transport the Fluor-S MAX scanner uses a scan arm lock-down screw. The screw which is located on the rear panel of the instrument, restrains the scan arm during transport and must be removed before power is supplied to the scanner. If the screw is not removed the scanner may be damaged. To release the locking screw, use a Phillips head screwdriver to turn the screw in a counter-clockwise direction until it protrudes approximately one cm. (Figure 3.2).

1. *2.*

Fig. 3.2. Scanning lock-down screw in the locked (1) and unlocked position (2).

3.2.5 Connecting the System Cables

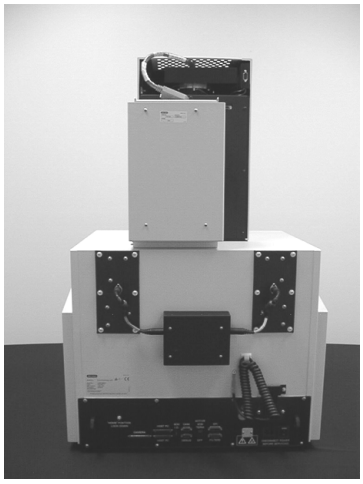
The Fluor-S MAX is supplied with several cables, which must be installed prior to the system being operated. These cables should be connected using the following procedure (Figure 3.3):

1. Connect the camera control cable (high density AIA, part no. 800-5239) from the female port labeled "CAMERA" on the scanning module to the female port labeled "AIA Controller" on the top of the camera controller.
2. Connect the camera power cable (9-pin, part no. 800-5330) from the female port labeled "CAM." on the scanning module to the vertical male port (unlabeled) on the optics module tower.
3. Connect the epi control cable (short 15-pin, part no. 800-4951) from the female port labeled "EPI" on the scanning module to the male port (unlabeled) on the underside of the black epi control box, in the middle of the scanning module's back panel.
4. Connect the filter control cable (long 15-pin, part no. 800-4938) from the male port labeled "FILTERS" on the scanning module to the horizontal male connector (unlabeled) on the optics module tower.

Caution: Do not touch the cable's pins during or after removal of the blue shorting plug. The camera CCD is static sensitive and static discharge from your hands to the pins may destroy the CCD.

5. Connect the camera HD cable (37-pin, part no. 37-021-003). One end of this cable is permanently attached to the camera. Remove the blue shorting plug from the

other end and connect it to the port labeled “CAMERA” on the top of camera controller.



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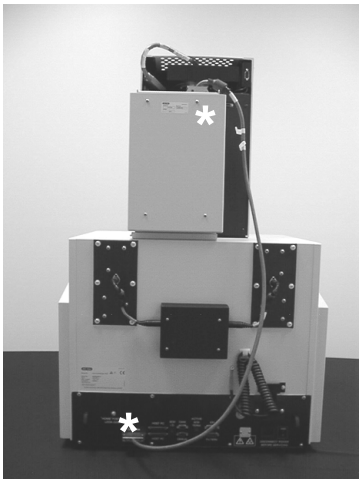

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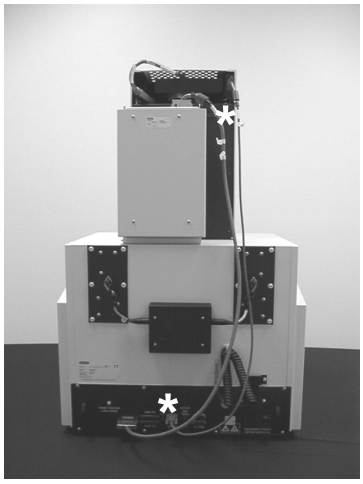

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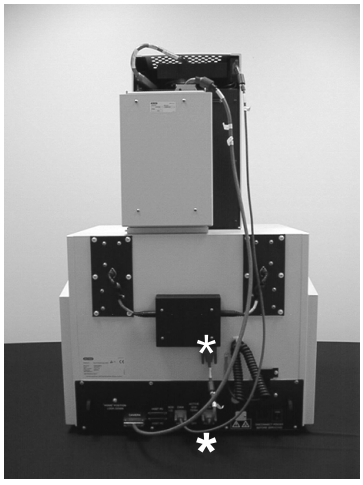

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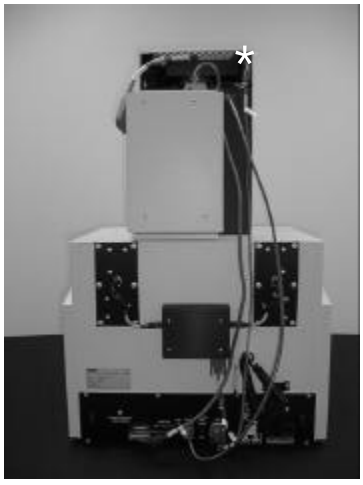

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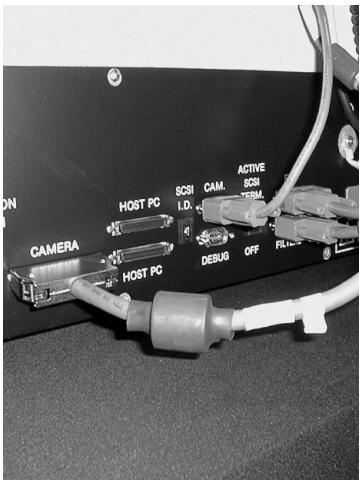

8.

Fig. 3.3. Steps for installing the system cables.

3.2.6 Installing the Emission Filters

The Fluor-S MAX is supplied with three emission filters and one clear filter that must be installed in the 8-position filter wheel before use. These filters are:

#1 520LP (Long Pass) - used for most single-color fluorescent stains and labels.
#2 530BP (Band Pass) - used for detection of green signal (FITC etc.) in multi-color fluorescence experiments (500-560 nm bandwidth)
#3 610LP (Long Pass) - used for detection of red signals (Texas Red etc.) in multi-color fluorescence experiments.
#4 Clear - used for colorimetric applications.

To correctly install the emission filters follow the procedure below (Figure 3.4):

1. Open the door to the optics module by placing your fingers in the slot on the right-hand side of the door and pulling the door gently towards you. This will expose the camera, filter assembly, filter advance button and the lens mount assembly.
2. Remove the filter wheel cover by fully unscrewing the left captive thumbscrew and loosening the right screw. The cover should now rotate down to expose the filter wheel.
3. Push the filter advance button until filter position #1 is in the center front position. The #1 label should be clearly visible on both sides of the filter slot.
4. Remove filter #1 from its packaging and check that it is clean; free of dust, fingerprints and scratches. If the filter is dirty it should be cleaned with the materials provided in the lens and filter cleaning kit.
5. Holding the filter by the numbered tab with the number in the correct orientation, carefully slide the filter into the open filter wheel position. Remember to be careful when inserting the filter so that you do not touch either side of the filter glass as this may effect system image quality.
6. Repeat steps 3-5 for the remaining filters (#2, #3 and #4)
7. Replace the filter wheel cover and hand-tighten both the right and left captive thumbscrews to secure.
8. Close the optics module door firmly. The filter wheel will automatically reset to the home position and is now ready for operation.

The above procedure can also be used for the installation of custom filters.

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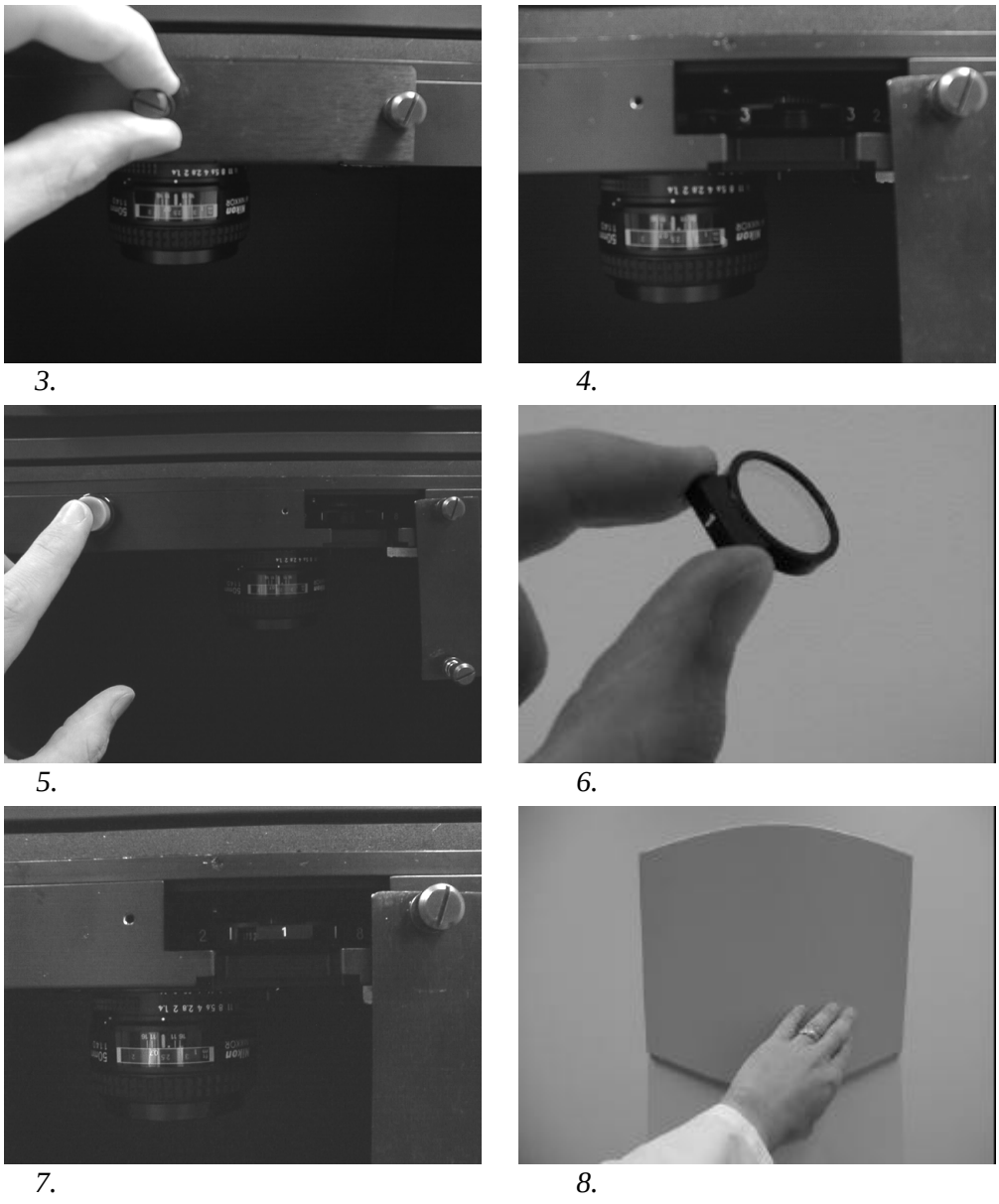
Fig. 3.4. Steps for installing the emission filters.



3. *4.*

5. *6.*

7. *8.*

Fig. 3.4. continued. Steps for installing the emission filters.

3.2.7 Installing the Lens

The Fluor-S MAX system is supplied with two standard lenses, a flexible zoom lens and a high NA 50 mm lens with improved collection efficiency.

Zoom Lens for Fluorescence and Colorimetric Imaging

The 28-80 mm Tamron zoom lens is recommended for use with all fluorescence and colorimetric applications and for high intensity chemiluminescence experiments. This lens allows good zoom flexibility, with a maximum image area of 30 x 30 cm and a minimum image area of 15 x 15 cm. The zoom lens is not a high numerical aperture (NA) lens and should not be used for low intensity chemiluminescence experiments.

The longer working distance of this lens also prevents it from being used in combination with the chemiluminescence tray.

High Numerical Aperture Lens for Chemiluminescence Imaging

The 50 mm high NA (f 1.4) lens is designed for optimized light collection efficiency and should be used for all low intensity chemiluminescence experiments. The lens can also be used for collecting typical fluorescence and colorimetric images, however the imaging area is fixed at 16 x 16 cm. This lens also works in combination with the chemiluminescence sample tray to place the sample closer to the camera and improve light collection efficiency. When the 50 mm lens and chemi tray are used in combination the image area is 11.5 x 11.5 cm.

Infrared Cutoff Filter

When performing any fluorescence experiments it is recommended that the 660 nm infrared cut-off filter that is supplied with the Fluor-S MAX is installed on the front of collecting lens. This filter will block any infrared signal that may be generated by the UV bulbs, substantially reducing image background and improving sensitivity. This lens is not required for chemiluminescence experiments and should not be present when collecting low intensity chemiluminescence signals as it will reduce the amount of signal collected.

Lens Use Recommendation

For optimal image acquisition, it is recommended that the zoom lens with 660 nm cut-off filter installed is used for all fluorescence and colorimetric applications and that the 50 mm fixed lens with no cut-off filter is used for all chemiluminescence experiments.

Zoom Lens Installation

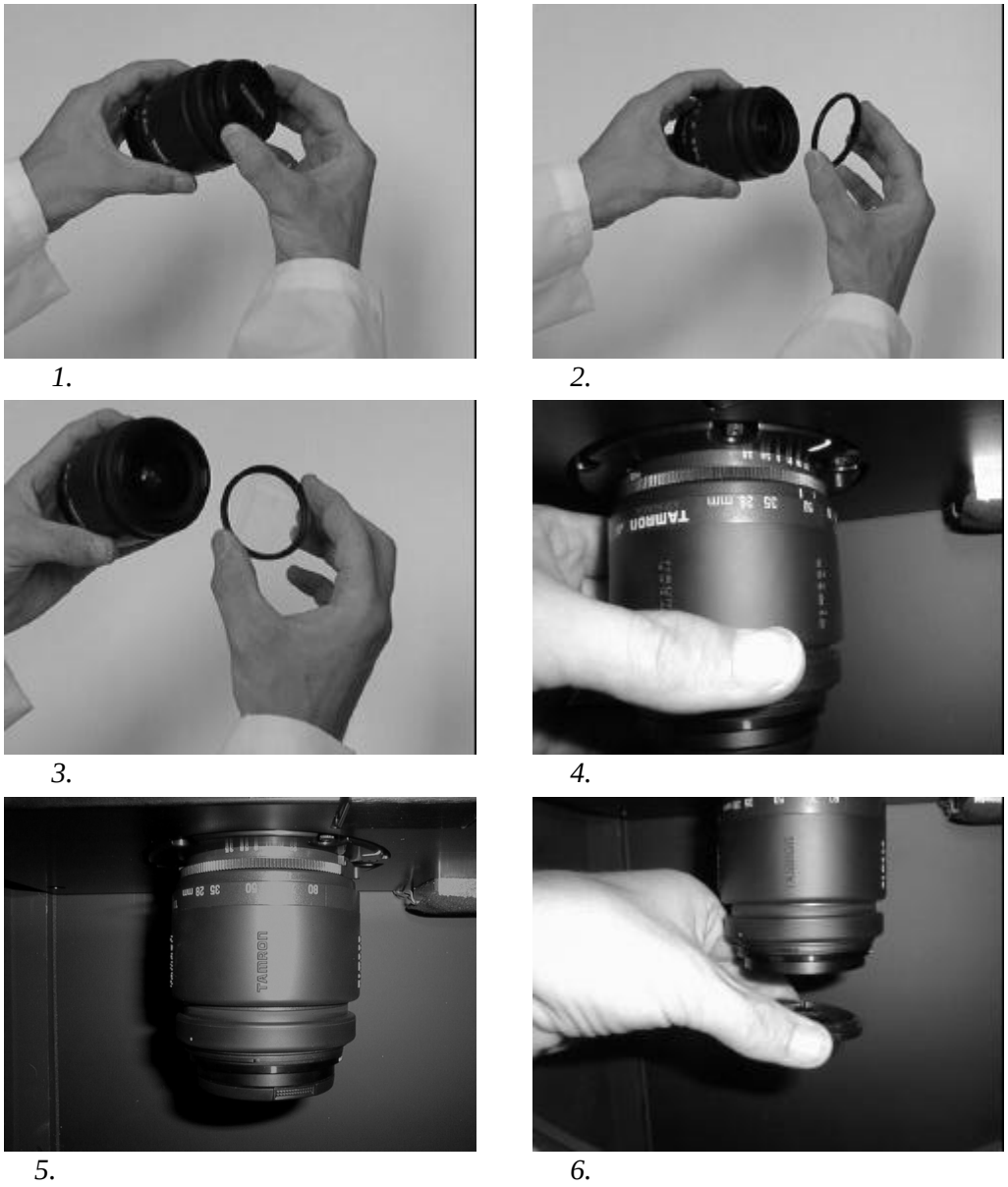
To correctly install the zoom lens follow the procedure outlined below (Figure 3.5):

1. Remove the lens from its packaging and retain the packaging for future storage.
2. Remove the front lens cap and install (screw on) the step-down (58<->52) ring adapter.
3. Install the 600 short pass (SP) filter onto the front of the lens by threading it onto the step-down adapter ring.
4. Remove the protective cover from the lens mount (rear of lens) and check that the lens is clean, free of dust fingerprints and scratches. If the lens is dirty it should be cleaned with the materials provided in the lens and filter cleaning kit.

Caution: For new users familiarizing themselves with operation of the Fluor-S MAX, it is recommended that the protective cover supplied with the system be placed over the platen area during insertion and removal. This will prevent component damage if the lens is accidentally dropped.

5. Open the door to the optics module and position the lens so that the strong white line on its mount matches the white mark on the base at the right hand side of the camera assembly.

6. Insert the mount of the lens into the base of the camera assembly and turn the lens counter-clockwise (to the right) until you hear it click into place. The white mark on the lens should now be directly in front of you.
7. The lens in now locked into position and the lens cap and protective platen cover can be removed.



1. *2.*

3. *4.*

5. *6.*

Fig. 3.5. Steps in zoom lens installation.

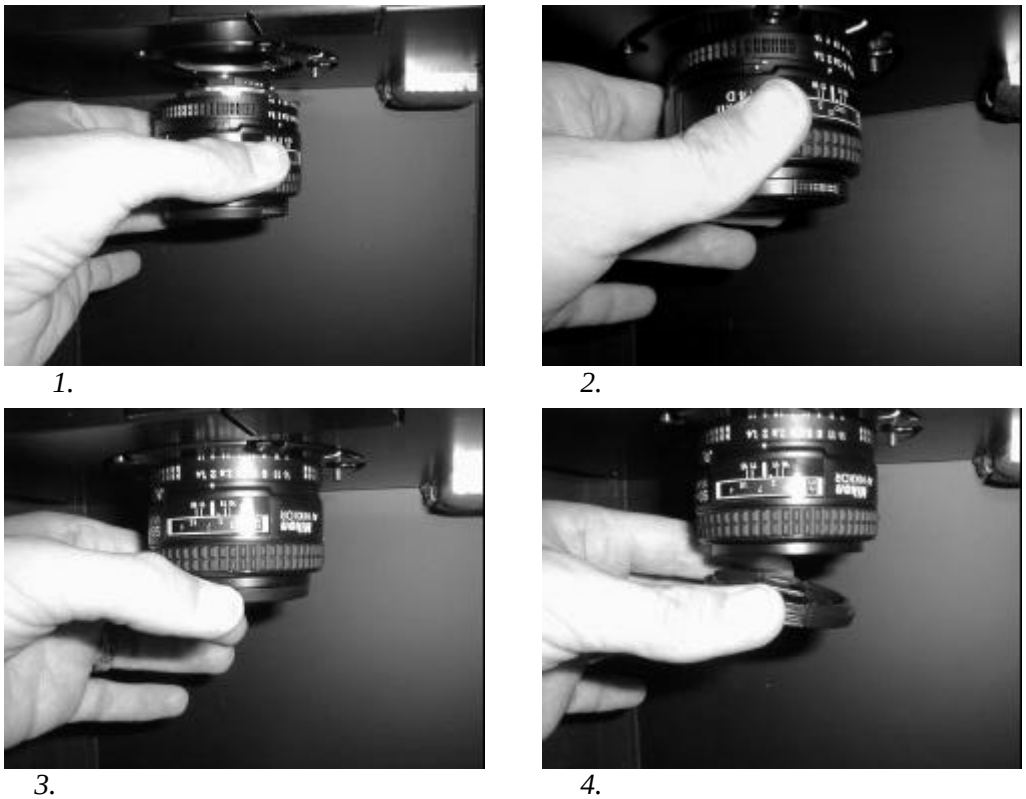
High 50 mm Lens Installation

To correctly install the 50 mm high NA lens, follow the procedure outlined below (Figure 3.6):

1. Remove the lens from its packaging and retain the packaging for future storage.
2. Remove the protective cover from the lens mount (rear of lens) and check that the lens is clean, free of dust, fingerprints and scratches. If the lens is dirty it should be cleaned with the materials provided in the lens and filter cleaning kit.

Caution: For new users familiarizing themselves with operation of the Fluor-S MAX, it is recommended that the protective cover supplied with the system, is placed over the platen area during insertion and removal. This will prevent component damage if the lens is accidentally dropped.

3. Open the door to the optics module and position the lens so that the white line and dot on its mount matches the white mark on the base of the camera assembly.
4. Insert the mount of the lens into the base of the camera assembly and turn the lens counter-clockwise (to the right) until you hear it click into place and the main white line is directly in front of you.
5. The lens in now locked into position and the lens cap and protective platen cover can be removed.



1. *2.*

3. *4.*

Fig. 3.6. Steps in 50 mm lens installation.

Lens Removal

To remove the lens from the camera housing follow the procedure outlined below (Figure 3.7):

1. Place the lens cap on lens
2. Hold the lens firmly with your left hand throughout the remainder or the removal process so that it cannot be dropped accidentally.

Caution: For new users familiarizing themselves with operation of the Fluor-S MAX, it is recommended that the protective cover supplied with the system, is placed over the platen area during insertion and removal. This will prevent component damage if the lens is accidentally dropped.

3. Depress the red release button on the base of the camera housing. This is located to the rear, right-hand side of the lens.
4. Rotate the lens in a clockwise direction (to the left) to release it from the housing.
5. Pull the lens down and remove it from the optics module.
6. Replace the mount cover. If the lens is not being used for some time it is recommended that it be stored in its original packaging.

1.

2.

Fig. 3.7. Steps in lens removal.

3.2.8 Electrical and Communication Connections

Power

The power entry module of the camera is supplied configured for operation at 110 VAC. If you operate at 100, 220-8240 VAC, please ensure that the camera is converted before supplying power by viewing the voltage indicator on the top of the camera controller (Figure 3.8). If the Fluor-S MAX is not correctly configured contact your local Bio-Rad representative. After confirming that the system is configured correctly insert the power cords into the power entry module on the rear panel of the scanner and on the top surface of the camera controller.

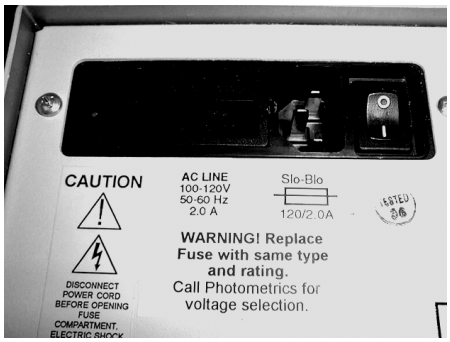


Fig. 3.8. Camera power module and voltage indicator.

SCSI Connection

The Fluor-S MAX is connected to the host computer via a high-density SCSI interface (Figure 3.9). The SCSI ports are located on the rear of the scanner unit. Two SCSI cables are included with the Fluor-S MAX system; one is designed for PC connection (labeled PC-SCSI) and the other for Macintosh systems (labeled MAC-SCSI).

Caution: To prevent damage to the hardware, all instruments must be turned off before attempting to connect (or disconnect) the scanner to the host computer.

Upon insertion of the SCSI cable into the scanner, the SCSI port will automatically select operation as a SCSI terminator and the termination switch will be illuminated.

Note: The SCSI indicator light is not a power indicator and merely indicates that the scanner terminated and acting as the last device in a SCSI chain.

Fig. 3.9. View of SCSI connector, SCSI ID and terminator.

Changing SCSI Termination

The Fluor-S MAX is a selectable SCSI terminating device. This allows the system to be connected to the beginning, middle or end of a linked chain of SCSI instruments. If the Fluor-S MAX is the last SCSI device in a series of peripherals or the only SCSI device, the SCSI termination switch should be on.

Caution: Ensure that the scanning module is turned off before changing the SCSI terminator settings.

If desired, additional SCSI peripherals such as optical drives, zip drives and other storage devices may be installed post-scanner in the SCSI chain. The scanner does not have to be the last device in a SCSI chain.

If the scanner is not the last device in the SCSI chain, change the scanner to non-terminated mode by clicking the illuminated terminator switch to the off position. The SCSI light will then turn off.

Changing the SCSI ID

The Fluor-S MAX has a selectable SCSI ID (0-9) located on the rear panel of the instrument (Figure. 3.9). The factory set SCSI ID for the Fluor-S MAX scanner may conflict with other SCSI devices such as storage or hard drives. Communication conflicts can be eliminated by changing the number on the scanner's SCSI ID dial.

PC SCSI Connection

The PC SCSI connection requires that a SCSI card be installed in the ISA or PCI slot of the host PC. Attach the end of the SCSI cable without the large bead to the 50-pin port on the PC SCSI adapter. Attach the other end of the SCSI cable with the bead to the 50-pin female SCSI port 1 on the back of the scanner module. Clip the connector bails on the scanner to the sides of the SCSI connector to ensure good contact.

Macintosh SCSI Connection

Macintosh computers are supplied with an internal SCSI port as a standard component. The MAC-SCSI cable supplied with your Fluor-S MAX may be directly coupled to this port. Attach the small 'D' connector of the SCSI cable to the port on the Macintosh computer. Attach the other end of the SCSI cable with the bead to the 50-pin female SCSI port 1 on the back of the scanner module. Clip the connector bails on the scanner to the sides of the SCSI connector to ensure good contact.

Power On Sequence

Normally, the Fluor-S MAX optics controller should be switched on first followed by the scanning module. Only after these systems have been on for 30 seconds should the host computer be powered up. This protocol is required for the computer to recognize the Flour-S MAX scanner as a peripheral device; an exception is certain Power Mac configurations, where the computer must be turned on first.

3.2.9 Software Installation

Please refer to your Quantity One software instruction manual for comprehensive software installation procedures and for detailed guidelines on the installation of appropriate SCSI drivers.

Section 4
Operating the Fluor-S MAX

4.1 Starting the Fluor-S MAX System

Both the camera controller and the main scanning module must be turned on prior to using the Fluor-S MAX system. The camera should be turned on first and then the main scanner.

To turn on the camera controller press the power switch located on its top panel.
To turn on the Fluor-S MAX scanner, press the power switch located on the left-hand side of the rear panel of the instrument. The green LED indicator on the front of the scanning module will illuminate to confirm that power is being supplied. The start up initialization process takes approximately 30 seconds. After this time has elapsed the host computer can be turned on.

Note: If the LED indicator fails to illuminate and the scanner is inoperative check that all power cables are firmly attached and that power is being supplied to the unit. If the scanner remains inoperative or the Fluor-S MAX acquisition window cannot be opened on the host computer, please contact the Bio-Rad Technical Service Department for assistance.

The Fluor-S MAX scanner should be switched on at least 30 seconds before the host computer, to allow for complete initialization of the scanning mechanism. If the Fluor-S MAX is not fully operational before the computer is turned on, the system will not be recognized as an attached SCSI device and you will not be able to communicate with the Fluor-S MAX from the Quantity One acquisition window. With certain PowerMac configurations this start-up order must be reversed. If your PowerMac does not recognize the scanner following the standard start-up procedure, turn both units off and try powering up the computer before the scanner.

For best imaging results it is recommended that the Fluor-S MAX scanner be allowed to warm-up for 15 minutes before use. It is generally recommended that the system be left on indefinitely, unless it is not being used for a period of more than 48 hours as bulbs will not be consumed when the system is in the idle state.

4.2 Overview of Operational Steps

The user will typically complete the following series of steps when acquiring an image using the Fluor-S MAX:

1. Start the program and open the acquisition window
2. Select the desired application and scan area
3. Place the sample in the scanner and optimize its position
4. Adjust the lens aperture and zoom
5. Optimize focus
6. Select the exposure (acquisition) time

7. Acquire the image

4.3 Detailed Operating Procedures

4.3.1 Opening the Acquisition Window

After starting your computer, open the Quantity One acquisition and analysis program by double clicking on the Quantity One icon (Figure 4.1).

Fig. 4.1. Quantity One icon.

From the FILE menu select FLUOR-S MAX to open the instruments acquisition window (Figure 4.2).

Note: If the computer cannot establish communications with the Fluor-S MAX a message will indicate this and give the user the option of entering a simulation mode.

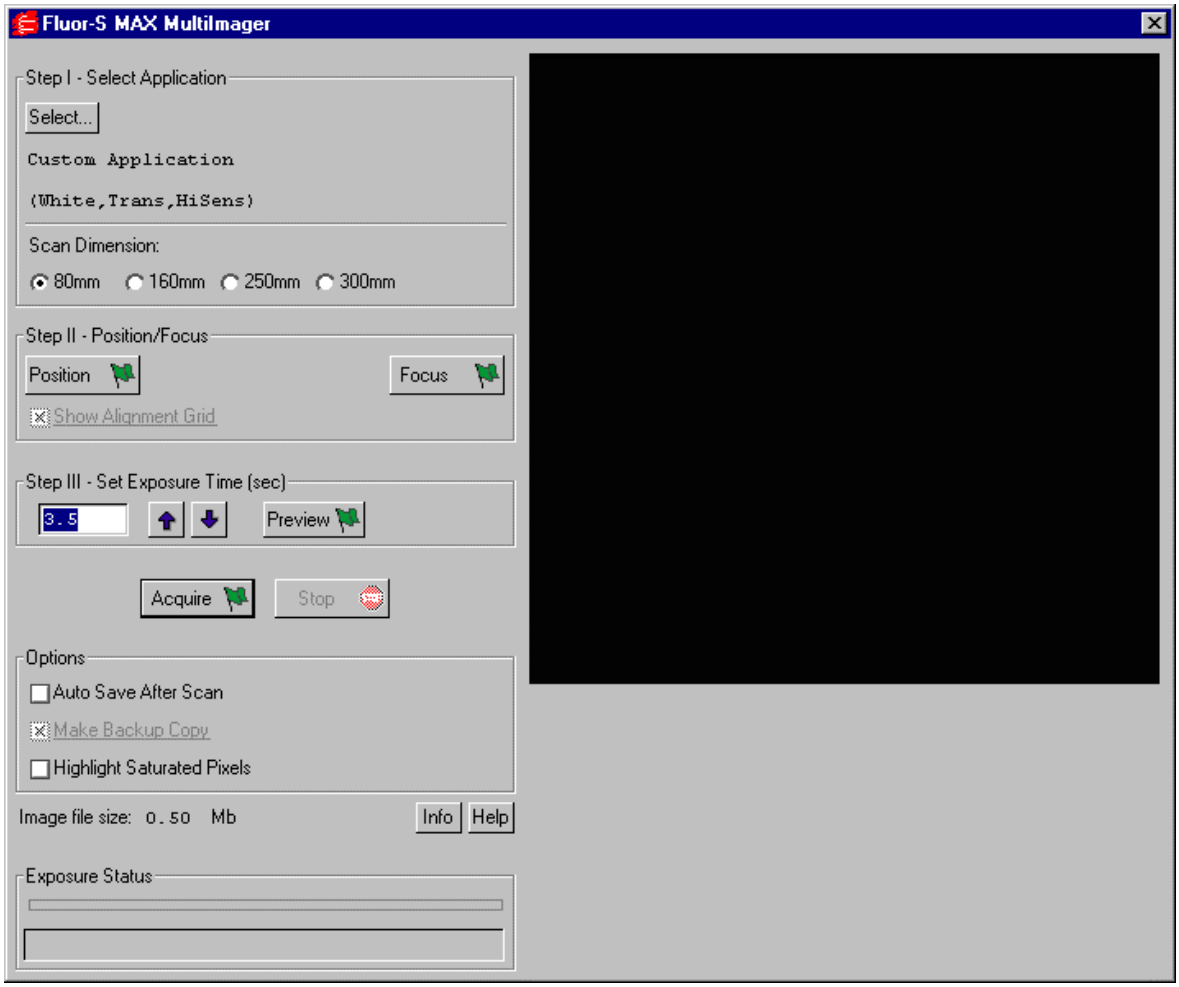


Fig. 4.2. Fluor-S MAX acquisition screen in Quantity One.

4.3.2 Selecting the Application & Scan Area

The Quantity One program uses an application-oriented format to simplify user selection of hardware collection parameters. To correctly set the hardware for collection, simply click the SELECT button in Step I (Figure 4.2) and identify the application name matching your sample type. For detailed acquisition instructions please refer to the Quantity One software instruction manual.

At this time if users are performing an application which employs scanning illumination they will be given the option of selecting the desired scan area. Users may select between a scan area of 80, 160, 250 and 320 mm. Select the scan area which matches the width of the sample.

4.3.3 Placing Samples in the Sample Chamber

The Fluor-S MAX can accommodate a variety of sample types and sizes. The sample stage is 40 x 60 cm and the imaging area located in the middle of the stage is 25 x 30 cm. This configuration supports the acquisition of smaller areas of interest within very large samples.

The sample stage and imaging area are liquid sealed so wet samples may be placed directly into the imaging chamber.

Caution: The sample stage area is resistant to most research chemicals but may be damaged by extended contact with strong acid solutions and organic solvents. When imaging samples exposed to these chemicals, users should wash the sample stage with water and wipe dry immediately after imaging.

Samples should placed in the Fluor-S MAX instrument following the steps outlined below:

1. Open the door to the sample chamber by lifting the protruding handle. The door has an automatic lift mechanism and only requires gentle upward pressure to open.
2. Visually check that the quartz imaging platen is clean. If not, clean using an optical cleaning solution and a soft lint-free or OptiWipes.
3. From the Fluor-S MAX acquisition window select the POSITION function in Step II (Figure 4.2). The image display window will now present a real time image of your sample in the chamber that refreshes every second.
4. Position your sample on the imaging platen, using the software generated alignment grid, to ensure that it is correctly placed and in the center of your viewing area.

Note: When imaging fluorescent gel samples it is recommended that the sample be removed from the glass or plastic plates of the gel sandwich before being scanned. The glass and plastic will fluoresce when exposed to UV light and will contribute to background signal.

Chemi Sample Tray

It is recommended that the chemi sample tray (Figure 4.3) be used for all small chemiluminescence samples (8 x 8 cm or less). The chemi tray slides onto the guides on the inside lower edge of each epi-illumination assembly and allows the sample to be placed closer to the camera. This increases both the amount of signal collected and the capture resolution. Large chemi samples should be imaged on the quartz platen.

Note: To insert and remove the chemi tray, the door to the sample chamber must be fully opened (second stop position).

Note: When using the Fluor-S MAX for non-chemiluminescence applications the chemi sample tray should be removed from the sample chamber as it will block sample light signal from the CCD camera.

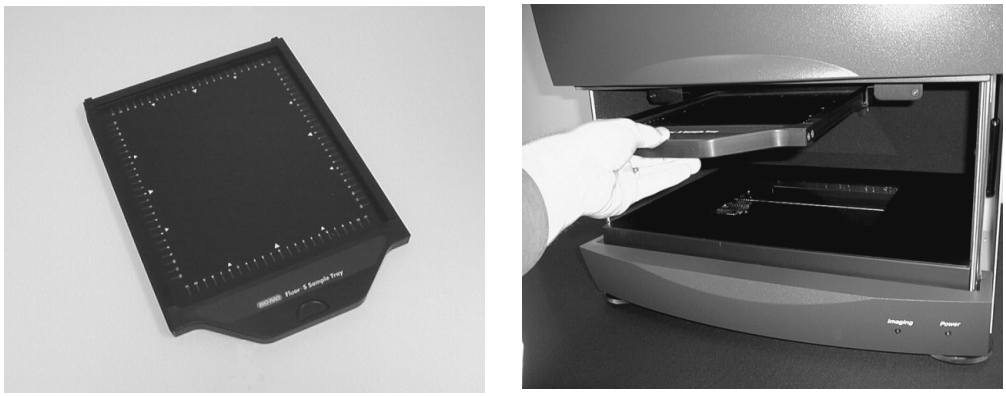


Fig. 4.3. Fluor-S MAX chemi sample tray.

White Light Diffusion Plate

It is recommended that the white light diffusion plate (Figure 4.4) is used when imaging colorimetric samples such as film and coomassie blue stained gels. This plate will further improve the uniformity of white light excitation.

To use the diffusion plate, simply position it directly onto the surface of the quartz platen. It will cover the entire 25 x 30 cm imaging area. Next place the sample onto the plate and position/focus as per normal protocol.

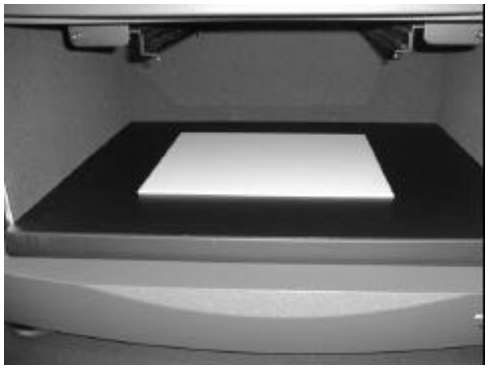


Fig. 4.2. White light diffusion plate.

4.3.4 Lens Selection and Setup

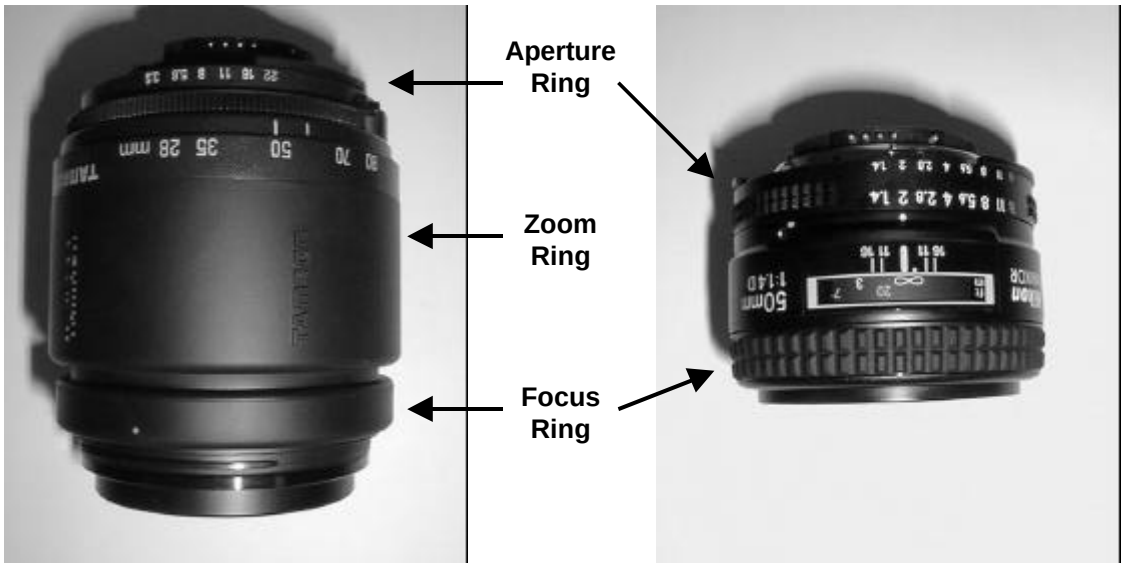
The Fluor-S MAX system is supplied with two standard lenses, a flexible zoom lens and a high numerical aperture 50 mm lens with improved collection efficiency.

For optimal image acquisition, it is recommended that the zoom lens with 660 nm cut-off filter installed is used for all fluorescence and colorimetric applications. This lens can also be used for high intensity chemiluminescence experiments, however it is not ideal for this type of application. The longer working distance of this lens also prevents it from being used in combination with the raised chemiluminescence tray.

For the best chemiluminescence results, it is recommended that the 50 mm fixed lens with no cut-off filter be used. The 50 mm high NA (f 1.4) lens is designed for optimized light collection efficiency and will produce superior images for all low intensity chemiluminescence experiments. The lens can also be used for collecting typical fluorescence and colorimetric images, however the imaging area is fixed. This lens is designed to work in combination with the chemiluminescence sample tray, placing the sample closer to the camera for improved light collection efficiency

Infrared Cutoff Filter

When performing any fluorescence experiments it is recommended that the 660 nm infrared cut-off filter that is supplied with the Fluor-S MAX be installed on the front of collecting lens. This filter will block any infrared signal that may be generated by the UV bulbs, substantially reducing image background and improving sensitivity. This lens is not required for chemiluminescence experiments and should not be present when collecting low intensity chemiluminescence signals as it will reduce the amount of signal collected.



1. *2.*

Fig. 4.5. Lens elements. (1) Tamron zoom lens, (2) Nikon 50 mm lens.

4.3.5 Aperture Adjustment

The aperture or f-stop ring is located at the top of the lens (Figure 4.5) and controls the amount of light that passes through the lens to be captured by the CCD camera. When the aperture is fully open, the f-stop number will be smallest, the depth of field will be smallest and the most light will pass through the lens. When the aperture is fully closed, the f-stop number will be largest, the depth of field will be greatest and the least light will pass through the lens. For low signal applications such as chemiluminescence, it is recommended that the aperture be fully opened to the smallest f-stop value.

Note: When the aperture on the zoom lens is fully closed (largest f-stop of 22), the aperture ring locks. To unlock the aperture ring push the black release button to the right of the f-stop indicators whilst simultaneously turning the ring to the right (counter-clockwise).

Note: The aperture ring on the 50 mm lens will not lock in the fully closed (f-stop 16) position, unless the user activates the lock mechanism on the lower right hand side of the f-stop indicators. To lock in this position move the button (white dot) up so that it aligns with the orange indicator. It is not recommended that the lens be locked in this position for chemiluminescence experiments as this setting allows the least light through the lens.

4.3.6 Zoom Adjustment

When using the zoom lens the view area of the image can be adjusted by rotating the zoom ring (Figure 4.5). The zoom ring is located directly below the aperture ring. At maximum zoom the indicator on the lens will be set to 80 mm, image resolution will be at its best and the view area on the quartz platen will be approximately 15 x 15 cm. At minimum zoom the indicator on the lens will be set to 28 mm, image resolution will be at its lowest and the view area will be approximately 30 x 30 cm.

The amount of zoom can be adjusted and viewed in real time by selecting the POSITION function in the Fluor-S MAX acquisition window. The image display window will now display a real-time image of the sample, as it will be captured. This image refreshes every second to help you optimize your zoom settings.

Note: The 50 mm lens offers no zoom adjustment.

4.3.7 Focus Adjustment

The focus ring is located at the very bottom of the lens (Figure 4.5) and determines the clarity of the captured image. If the sample offers clear contrast it can be used directly for focusing. For samples offering little contrast, the focusing target supplied with the Fluor-S MAX can be used to simplify this step. Normally once the lens is focused it will remain focused and should not require further adjustment.

4.3.8 Selecting Exposure Time

The exposure time refers to the period of time that the shutter will remain open and light will pass from the sample to the CCD. As such, the longer the exposure time, the brighter the captured image will be. For high intensity applications including colorimetric and high intensity fluorescence experiments, an exposure time of only a few seconds is typically required. For low intensity applications such as chemiluminescence, an exposure time of several minutes may be required. The exposure period required to produce an optimal image varies considerably and may need to be optimized for your particular sample. Typical exposure conditions for different sample types have been included in Table 4.1 as a guide to selecting a suitable exposure time. This table also indicates the preferred lens for the sample and if any accessories are recommended.

Table 4.1. Recommended exposure times and setup.

Sample	Recommended Exposure	Lens & Filter	Accessories Used
Fluorescent Stain Gel	3-30 sec.	Zoom/IR	None
Fluorescence End-Label Gel	30 sec. – 2 min.	Zoom/IR	None
Fluorescent Blot	0.1-3 sec.	Zoom/IR	None
Chemifluorescent Blot	0.1-3 sec.	Zoom/IR	None
Colorimetric Gel	1-10 sec.	Zoom/IR	White Diffusion Plate
Colorimetric Blot	0.2 to 10 sec.	Zoom/IR	None
X-ray film	1-10 sec.	Zoom/IR	White Diffusion Plate
Weak Chemiluminescence	2-10 min.	50 mm	Chemi Tray (is sample is small)
Strong Chemiluminescence	10 sec. – 2 min.	50 mm	Chemi Tray (is sample is small)

4.3.9 Acquiring the Image

To collect the sample image, simply press the ACQUIRE button. The software will automatically set all instrument collection parameters and transfer the captured image to the Quantity One program for storage and analysis.

The yellow LED on the front panel of the Fluor-S MAX will flash during acquisition to indicate that the image is being captured.

After the image has been acquired and saved its presentation can be manipulated in order to optimize its appearance. The image may also be analyzed in various ways using the Quantity One program; including object volume analysis, lane profile analysis including regression analysis and molecular weight determination, colony counting, fingerprinting, VNTR and differential display studies. The image and data reports may also be printed or exported to other software programs. Please refer to the Quantity One software manual for detailed instructions.

Section 5
Care and Maintenance

5.1 General Maintenance

With regular use the Fluor-S MAX system should provide years of trouble-free operation without any need for regular operator maintenance other than cleaning. If you suspect that the Fluor-S MAX requires servicing, please contact your local Bio-Rad office.

The outside surface of the Fluor-S MAX should be periodically cleaned with water, mild liquid soap and a sponge or soft cloth towel.

Caution: Never use abrasive cleaners, solvent based cleaners, alcohol or scouring pads to clean the external surface of the instrument.

Caution: Always disconnect the Fluor-S MAX from electrical power prior to cleaning the external surface of the instrument.

It is recommended that the casing of the scanning module be periodically inspected to verify that no panels are loose or distorted so as to allow access to UV energy. It is also recommended that the operation of interlocks be periodically checked.

5.1.1 Cleaning the Quartz Platen and Sample Stage Area

The quartz platen and sample stage of the Fluor-S MAX should be cleaned between imaging sessions to optimize image quality. Use power-free gloves when cleaning the instrument to avoid fingerprints that may appear during imaging. Never wear powered gloves when cleaning the Fluor-S MAX. Clean the quartz platen with optical cleaning solution and an optical tissue such as OptiWipes™. A cleaning kit is available from Bio-Rad.

Caution: It is recommended that water, mild liquid soap and a soft sponge be use to clean the sample stage. Never use abrasive cleaners, solvent-based detergents or scouring pads to clean the quartz surface.

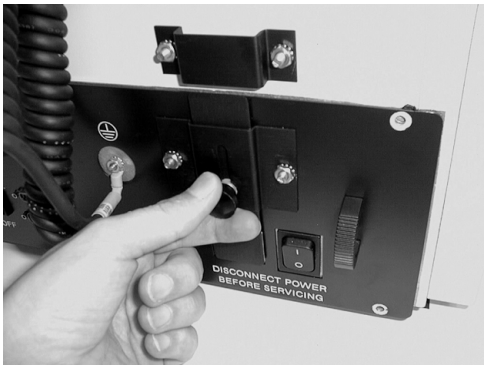
5.1.2 Cleaning the Scanning Illumination Mechanism

The scanning illumination mechanism should also be periodically cleaned to remove dust and optimize image quality. To clean the mechanism, follow the steps outlined below (Figure 5.1).

1. Turn off the Fluor-S MAX and disconnect all power, removing the two power cables.
2. Rotate the Fluor-S MAX so that the back surface is accessible.
3. Remove all cables attached to the bottom access panel.
4. Remove the eight screws that hold the rear access panel in place using a Phillips screwdriver.

5. Unscrew and remove the grounding strap from the main case.
6. Slide down the safety interlock to release the rear access panel.
7. Gently slide the entire access panel and scanning illumination mechanism assembly 10 cm out of the instrument.
8. Disconnect the electrical connector located at the middle of the left-hand side of the illumination mechanism and remove the cable from the retaining clamp.
9. Clean the top filter glass of all the illumination sources using optical cleaning solution and optical tissue.
10. Once the filters are clean, reinsert the illumination mechanism by reversing the procedure above. Remembering to reconnect the electrical connector, reinsert the cable in the retaining clamp and replace the screws. You should move the scan arm to the very left and verify that the cables do not interfere with its movement.
11. Lift up the power safety interlock and reapply power to the system.
12. Rotate the Fluor-S MAX back to its normal operating position.

1.



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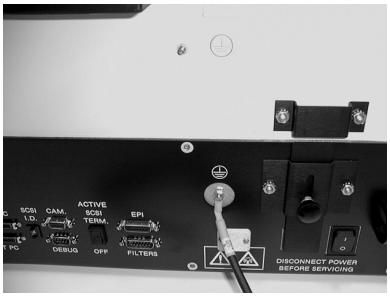

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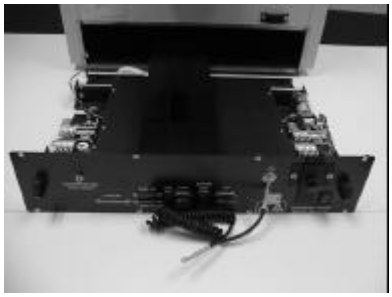

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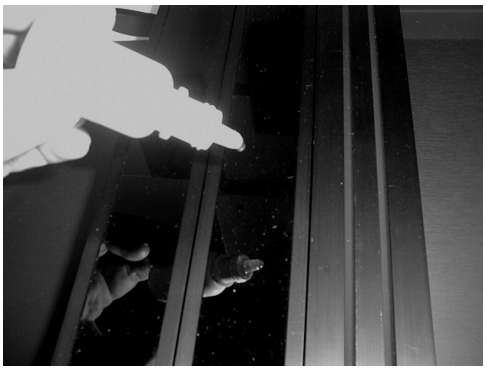

6.

7.

Fig. 5.1 Steps in cleaning the scanning illumination mechanism.

5.1.3 Cleaning the Lens

To optimize image quality it is recommended that any lens used with the Fluor-S MAX be cleaned before it is installed in the system. Both sides of the lenses should be cleaned using an optical cleaning solution and optical tissue. Avoid touching the glass surfaces of the lens when installing it into the instrument, as fingerprint will effect image quality.

5.1.4 Cleaning the Emission Filters

To optimize image quality it is recommended that the emission filters installed in the Fluor-S MAX system be cleaned periodically. Both sides of each emission filter should be cleaned using an optical cleaning solution and optical tissue. Avoid touching the glass surfaces of the filter when installing it into the instrument, as fingerprint will effect image quality.

5.2 Replacing Illumination Sources

The life of the broad wavelength UV bulb is approximately 500 to 1000 hours depending upon use. As the bulbs age, the required integration time will increase because the intensity of the UV emission will diminish. If the integration time for image acquisition has increased more than three-fold, it is recommended that the bulbs be replaced. The life of the white light bulb in approximately XX hours.

5.2.1 Replacing the Bulbs in the Scanning Module

To access the bulbs in the scanning mechanism follow the procedure outlined in section 5.1.2.

Caution: Do not touch the glass parts of the bulb or bulb housing. Fingerprints on the bulb may result in non-uniform illumination. The use of power-free latex gloves is highly recommended.

To change the bulb, follow the procedure outlined below (Figure 5.2):

1. Lift the end of the scanning arm that is closest to the rear panel of the scanning assembly and remove the three Phillips screws located at the end of the assembly.
2. Remove the end plate and then the metal and glass excitation filters (light shields) from the bulb housing.
3. Remove the yellow retaining tape and keep for reuse.
4. Whilst grabbing the two metal of the bulb, carefully rotate the bulb and remove it from the housing sockets.
5. Install the replacement bulb by inserting its ends in the sockets and rotating until it clicks into place.
6. Replace the retaining tape.
7. Reinstall the excitation filters (light shields) and screw back in place.
8. Clean and reinstall the scanning assembly as detailed in section 5.1.2.

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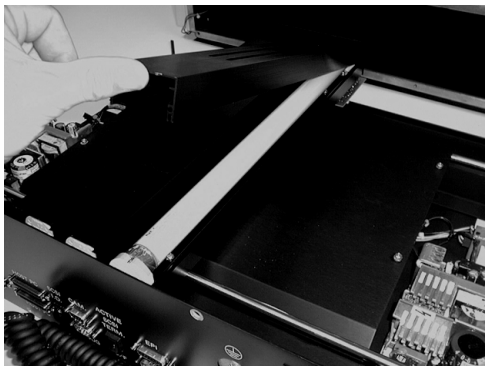
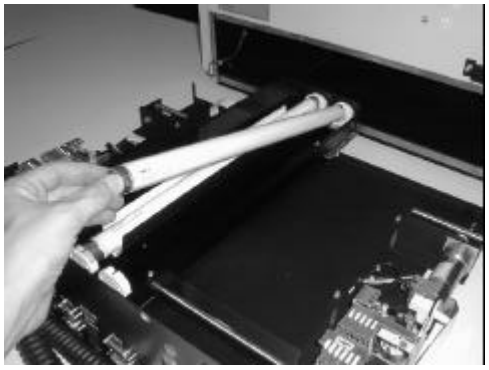


3.

4.



5.

Fig. 5.2 Steps in replacing a bulb in the scanning illumination mechanism.

5.2.2 Replacing Bulbs in the Epi-illumination Module

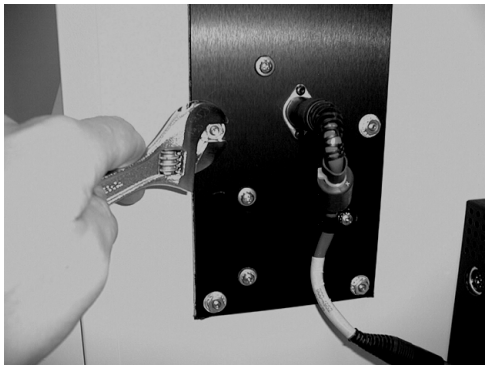
The Fluor-S MAX has two epi-illumination modules, each of which contains a single white illumination source and two broad bandwidth UV sources. Both the right and left epi-assemblies must be accessed through the back panel of the scanning module.

To change an epi- bulb, follow the procedure outlined below (Figure 5.3):

1. Turn off the Fluor-S MAX and disconnect all power, removing the two power cables.

2. Open the door to the sample compartment and remove the chemi sample tray guides located on the inside edge of both epi-modules by loosening the two thumb screws.
3. Rotate the scanning module to permit access to the epi modules.
4. Disconnect the control cables from the epi-illumination control box at the back of the instrument. If you are replacing a bulb in only a single epi-assembly only the cable to this assembly should be removed.
5. Using a nut driver remove the six nuts that secure the epi-assembly to the rear of the scanning module.
6. Carefully use a broad flat headed screw driver to break the seal between the epi-assembly and the main case.
7. Carefully slide the entire epi-assembly out of the scanner and remove it completely from the sample chamber.
8. To replace a white light bulb simply grabbing the two metal ends of the old bulb and carefully rotating to release it from the sockets.
9. Install the replacement white light bulb by placing its ends in the sockets and rotating until it clicks into place. Be careful not to touch any glass surfaces of the bulb or the reflecting mirror.
10. To replace the UV bulb remove the four thumbscrews from the side panel of the epi-assembly.
11. Remove the side panel.
12. Slide the UV filter along its channel and remove it from the assembly.
13. Loosen the two thumbscrews located along the length of the housing and disassemble to allow easy access to the two UV bulbs.
14. To remove the bulb, grab the two metal ends and rotating to release it from the sockets.
15. Install the replacement UV bulb by placing its ends in the sockets and rotating until it clicks into place. Be careful not to touch any glass surfaces of the bulb or reflective mirror.
16. Reassemble the UV epi-assembly, reinsert the filter, align and tighten the four thumbscrews and reinsert the entire epi-assembly by reversing steps 8 – 10 above.
17. Align the insertion guides on the top of the epi-assembly with those in the chamber, slide the epi-assembly back into the scanning module and tighten all six nuts firmly using the wrench.
18. Reassemble the chemi sample tray guides to the epi-module with the two thumb screws for each guide.
19. Reconnect power to the system and restart the Fluor-S MAX.

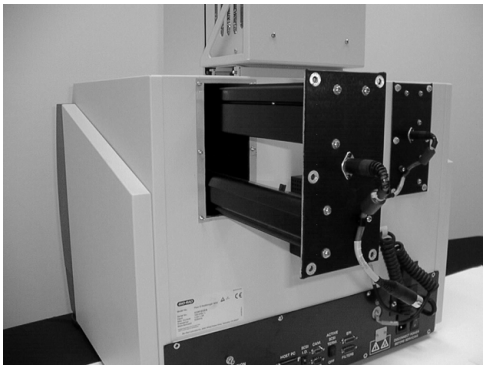
1.



2.

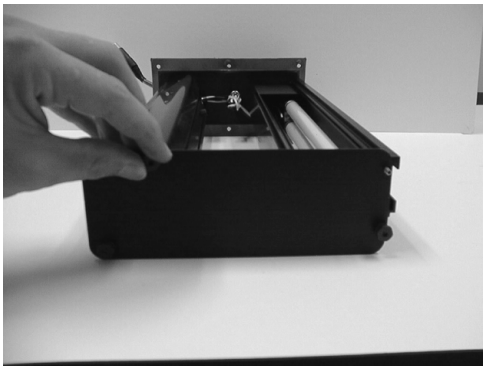
Fig. 5.3 Steps in replacing a bulb in the epi-illumination mechanism.

3.



4.

5.



6.

7.

8.

Fig. 5.3. continued. Steps in replacing a bulb in the epi-illumination mechanism.

To order replacement bulbs contact either Bio-Rad Laboratories or your local distributor (see the manufacturers part number on the bulb).

5.3 Lens and Filter Storage

Always store unused lenses and filters in their original box, in a low humidity environment with a stable ambient temperature that does not exceed 30 °C.

Lenses should be wrapped in optical tissue before being placed in their storage box.

If your lab is a high humidity environment it is recommended that all emission filters are stored in a sealed container with desiccant.

Section 6
Troubleshooting & Technical Information

6.1 Problem Solving Guide

Problem	Possible Cause	Solution
Fluor-S MAX is not responding to host computer	Power is not supplied or the scanner or camera are not switched on	Ensure power is supplied and both the scanner and camera power switch are turned on
	Scanner door is open	Close Door
	SCSI cable is not properly connected to scanner or computer	Reconnect SCSI cable and ensure it is seated properly
	Filter cable or camera cable is not properly connected	Makes sure that the cables are connected and seated properly
	SCSI ID conflict	Change SCSI ID setting
	Fluor-S MAX is operating as a stand alone or last item and is not terminated	Turn on the SCSI termination switch
	SCSI cable is defective	Replace SCSI cable
	Start-up sequence is incorrect	Turn off all components and restart in opposite sequence
	Computer has a conflicting program or initiation (init.) file	Contact Bio-Rad for assistance
Image is not visible on the monitor or only low signal counts are detected	The 'Transform" function in the software is set too high	Set to a lower maximum value
	Lens cap is covering lens	Remove lens cap
	Insufficient integration time	Integrate sample for a longer time
	Chemi tray not removed when imaging non-chemi sample	Remove chemi tray from sample chamber
	Wrong application selected	Verify / reselect correct application
	Wrong scanning area selected	Verify / reselect correct scanning area
	Bad lamp	Replace lamp
	Dirty optics	Ensure that platen, filter and lens are clean
Image intensity varies across the scan	Bad lamp	Replace lamp
UV scanning or epi-illumination not working	Door to either optical module or scanning module is open	Ensure doors are closed properly
Scanned image has horizontal streaks	Dust or small particles on the scanning source	Clean the scanning assembly
Fluorescent image has spots	Dust or small particles on the quartz platen or optics	Clean the quartz platen, lens and filters
White light Image has vertical lines	White light scanning plate was not used	Insert the white light scanning plate and rescan sample

Fluorescent image has high background	Image was scanned without being removed from glass plate	Remove plate from sample. Thin polyacrylamide samples can be transferred to exposed x-ray film and imaged using UV-epi mode
	660 nm filter is not in place	Install 660 nm filter onto lens
	Wrong application selected	Verify / reselect correct application
	Light leak	Check for light leaks, ensure optics module tightly connected to scanner
	High fluorescence agarose used	Use low fluorescence agarose
	Auto-fluorescence from sample	Remove sample and perform control scan
	Destain (if appropriate) was insufficient	Increase destain
Filter wheel does not turn	Obstruction in filter wheel housing	Check for and remove obstruction
	Cable was removed when power was on, damaging main board	Contact Bio-Rad for assistance
	Unmodified lens is causing obstruction	Contact Bio-Rad for assistance
	Bad filter wheel cable or connection	Reconnect / replace cable
Epi bulbs are not turning on	Bad lamps	Replace lamps
	Door interlock not working	Contact Bio-Rad
Integration time to acquire image has increased	Bulb intensity has decreased with age	Replace bulbs
	Image area has increased	Verify scan area selected
Poor chemiluminescence sensitivity	Incorrect application selected	Verify application is correct for sample
	Incorrect lens used	Use the 50 mm high NA lens for best chemi results.
	Sample on platen with chemi tray installed	Place sample on chemi tray or remove tray from sample chamber
	Incorrect f-stop setting	Adjust f-stop to a lower value. f 1.4 recommended.
	The 660IR cutoff filter was not removed from the lens	Remove 660 cutoff filter
	Insufficient integration time	Integrate sample for a longer time

6.2 Technical Service

For technical assistance with the Fluor-S MAX system including all hardware and software, contact your local Bio-Rad office, or in the US call 1-800-424-6723. All spare parts not listed in this document can be ordered by contacting your local Bio-Rad office.

For inquiries and requests regarding system repair or service, contact your local Bio-Rad office or distributor (in the U.S., call Technical Service at 1-800-424-6723). Please have the following details available:

1. Instrument model and catalog number.
2. Serial number (located on the back of the optics module door).
3. Hardware, firmware and software version information (in operating software, "About" box).

6.3 Fluor-S MAX System Specifications

System Technical Specifications	Specification
Linear dynamic range	> 3 orders
Pixel density	16-bit (0-65,535)
Image resolution	200µm (greater resolution with optional lenses)
Light source	
Scanning illumination	UV (290 - 365 nm) and white light (400 – 750 nm)
Epi illumination	UV (290 - 365 nm) and white light (400 – 750 nm)
Emission filters	8 position filter wheel: 520LP, 530DF60, 610LP and clear filters supplied
Scanning area	25 x 30 cm
Sample area	40 x 60 cm
Operating Conditions	
Supply voltage	100-120 or 220-240 VAC $\pm$ 10%
Frequency	50-60 Hz
Operating Temperature	10-32°C (21°C recommended)
Operating Humidity	30-80%, non-condensing
Dimensions	68 cm (L) x 54 cm (W) x 109 cm (H)
Total Weight	69.5 kg

Super Cooled CCD	Specification
Imaging array	512 x 512
Pixel size	24 x 24 micron
Pixel depth	16-bit
CCD size	12.3 x 12.3 mm
Detector type	Back-illuminated high sensitivity CCD with anti-reflective coating
Cooling system	Forced air 3 stage peltier thermoelectric system
Cooling range	0 to -35°C
Cooling stability	0.1°C
Linear Dynamic Range	> 3.7 orders
Dark current	Typically 1.3e/pixel/sec.
Sensitivity	0.4 x 10^{-5} Watts

6.4 Fluor-S MAX Warranty Information

This warranty statement may vary outside of the continental United States. Please contact you local Bio-Rad office for the exact terms of your warranty.

Bio-Rad laboratories warrants to the customer that the Fluor-S MAX system (catalog number 170-7720) will be free from defects in material and workmanship and will meet all of the performance specifications for a period of one year from the date of shipment. This warranty covers all parts and labor.

If any defects should occur during this period, Bio-Rad Laboratories will either replace or repair the defective parts free of charge. For the exact terms of warranty, please see the Instrument Warranty Card.

In the event that the Fluor-S MAX must be returned to the factory for repair under warranty, the instrument must be packed and returned in its original shipping container.

Bio-Rad shall not be liable for any incidental, special or consequential loss, damage or expense, directly or indirectly arising from use of the Fluor-S MAX system. Bio-Rad makes no warranty whatsoever in regard to products or parts furnished by third parties, such being subject to the warranty of their respective manufacturers. Service under this warranty shall be requested by contacting your nearest Bio-Rad office.

This warranty does not extend to any instruments or parts thereof that have been subject to misuse, neglect, or accident, or that have been modified or serviced by anyone other than Bio-Rad or its representative, or that have been used in violation of Bio-Rad instructions. It also does not extend to instruments or parts thereof that have been used with fittings or other spare parts not authorized by Bio-Rad Laboratories, that are interfaced to inappropriate external devices, that have been exposed to inappropriate solvents, cleaning agents or samples. The warranty also does not cover instrument damage resulting from facility problems such as power surges.

The foregoing obligations are in lieu of all other obligations and liabilities including negligence and all warranties of merchantability, fitness for a particular purpose otherwise expressed or implied in fact or by law, and state Bio-Rad's entire and exclusive liability and buyers exclusive remedy for any claims or damages in connection with the furnishing of goods or parts, their design, suitability for use installation and operation. Bio-Rad Laboratories will in no event be liable for any special, incidental or consequential damages whatsoever, and Bio-Rad's liability under no circumstances will exceed the contract price for the goods for which liability is claimed.

6.5 Glossary of Imaging Terms

CCD:	Charge-Coupled Device.
CCD Element:	Each CCD element or pixel is capable of detecting light and storing the resulting electronic information.
CCD Array:	A CCD array can be visualized as a periodic grid array of individual CCD elements, (analogous to a water buckets). When the shutter is open, photons of light (analogous to drops of rain) fall into the photo-detectors (water buckets).
Integration:	When the camera shutter is open and the CCD is exposed to light.
Thermoelectric Cooler:	The CCD is cooled to –35°C by a triple stage Peltier cooler, a thermoelectric cooler (TEC) that pulls hat away from the CCD. The heat is transferred to the camera body which is cooled by forced air.
Dark Current:	Dark current arises from the creation of electrons generated through the process of thermal emission within the silicon layers comprising the CCD. Dark current noise is the square root of the number of dark current electrons. The presence of dark current is an additional concern in low light level applications. It is important to ensure that dark current noise dies not exceed read noise from the signal even when long integration times are used. CCD's can be chilled with TECs to a point that dark current is negligible.
Signal to Noise:	Signal to noise ratio (SNR) is the measure of the signal quality at a given pixel. It is the ratio of the measured signal to the overall measured noise at that pixel.
Dynamic Range:	Dynamic range of a CCD is simply defined as the ratio of CCD saturation to the read noise. It is the ability to quantitatively detect very dim and very bright pixels within a single image.
Quantum Efficiency:	Quantum efficiency is the measure of the effectiveness of an imager to produce electronic charge from incident photons. This is an especially important property when performing very low light level imaging.
Dead Pixels:	There are a variety of different grades of CCD chips. Each grade has some percentage of dead or bad pixels. These are typically displayed as white or dark lines on the image. Most CCD systems correct for dead pixels.
Image Resolution:	Image resolution refers to the spacing of pixels in the image and is measured in pixels per inch (ppi). If an image has a resolution of 72 ppi this means that it contains 5182 pixels (72 x 72) in a square inch.
Monitor Resolution:	Monitor resolution defines the number of dots or pixels per unit length of output. It is commonly measured in dots per inch (dpi). The monitor resolution determines the size of the displayed image and should not be confused with image resolution, which reflects the spacing of pixels in the image.